

**REMARKS**

Claims 13-37 are pending in the application. Claims 1-12 have been withdrawn from consideration without prejudice to Applicants' right to prosecute these claims in a timely filed divisional application. Claims 13 and 29 have been amended. New claim 38 has been added. Support for these amendments and the new claim may be found throughout the specification including, but not limited to, page 6, lines 17-21 and page 9, line 21 through page 10, line 2.

In view of the following remarks, reconsideration and withdrawal of the rejections to the patent application in the Office Action is respectfully requested.

**I. Rejection of Claims Under 35 U.S.C. § 103(a)**

In the Office Action, a number of references were combined with U.S. Patent Application No. 3,058,854 issued to Angello (hereinafter "Angello") in order to support claim rejections under 35 U.S.C. § 103(a). Claims 13-14, 20-24 and 27-28 were rejected as being unpatentable over Angello in view of U.S. Patent No. 5,363,796 issued to Kobayashi et al. (hereinafter "Kobayashi"). Claims 15-19, 29-35 and 37 were rejected as being unpatentable over Angello in view of Kobayashi and further in view of U.S. Patent No. 4,609,530 issued to Morioka et al. (hereinafter "Morioka"). Claims 25 and 26 were rejected as being unpatentable over Angello in view of Kobayashi and further in view of an article from the Journal of Crystal Growth authored by Lin et al. (hereinafter "Lin"). The Office Action rejected claim 21 as being unpatentable over Angello in view of Kobayashi and further in view of U.S. Patent No. 4,013,501 issued to Van Uitert (hereinafter "Van Uitert"). Claim 37 was rejected as being unpatentable over Angello in view of Kobayashi and Morioka and further in view of Van Uitert. Applicants respectfully traverse.

In order to establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a), the cited references, alone or in combination, must teach each and every limitation of the rejected claims. As amended, independent claims 13 and 29 recite a method for carrying out Czochralski crystal growth by heating a crucible with an upper heater and a lower heater which are separated by an insulator. As noted in the Office Action, Kobayashi describes a method of growing single crystal by the Czochralski method that includes heating a crucible with a main heater and a

subheater that are vertically separated. However, neither Kobayashi nor any of the other references cited in the Office Action disclose a method for carrying out Czochralski crystal growth using two heaters separated by an insulator. The presence of an insulator between the upper and lower heaters in the apparatus described in the rejected claims represents a significant distinction between the methods of the rejected claims and the methods recited in the prior art. As noted in the specification of the pending application on page 6, lines 27-30, the insulator effectively divides the upper section of the crucible and the lower section of the crucible. This helps maintain the difference in temperature between the upper region of the crucible and the lower region of the crucible by preventing the upper heater from heating the lower portion of the crucible and preventing the lower heater from heating the upper portion of the crucible. Therefore, the cited references failed to disclose each and every limitation of the rejected claims and Applicants respectfully request that this rejection be withdrawn.

## **II. Information Disclosure Statement**

Applicants have submitted an Information Disclosure Statement under 37 C.F.R. § 1.97(c) and accompanying form PTO-1449 concurrently with this Amendment and Request for Reconsideration. A copy of the reference cited therein, Brice, J.C., "The Bridgeman and Related Methods," Crystal Growth Processes, Chapter 3, pp. 104-107 (1986) (hereinafter "Brice"), is enclosed. Brice discloses an apparatus for carrying out crystal growth using the Bridgeman method. The apparatus includes two heating zones separated by a baffle. However, the apparatus of Brice is designed to carryout a Bridgeman crystal growth process that is very different from the claimed Czochralski crystal growth process. The Bridgeman process grows a crystal through the gradual crystallization of a melt within a crucible, rather than by pulling a crystal from a melt. Thus, Brice does not teach or suggest a method of growing a crystal involving the steps of heating an upper portion of a crucible with an upper heater to a temperature sufficient to melt a feed material in an upper portion of the crucible and separately heating a lower portion of the crucible with a lower heater to another temperature which is below the melt temperature of the feed material so that the feed material in the lower portion of the crucible remains solid. Nor does Brice teach a method of growing a crystal involving drawing a growing crystal out of a melt and advancing the crucible in which the melt is contained with

respect to two heaters as the crystal is drawn from the melt to heat additional portions of solid feed material with an upper heater to melt the additional solid material to replace the crystal drawn from the melt. Each of these steps is recited in the rejected claims. Therefore, Applicants respectfully submit that the pending claims are patentable over Brice.

### III. Conclusion

In view of the foregoing remarks, Applicants respectfully request that the Examiner reconsider and withdraw the pending rejections discussed above. Applicants also solicit an early notification of allowance. If Examiner Song has any questions, or believes a telephone discussion would expedite the prosecution of this application, he is invited to contact the undersigned.

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Respectfully submitted,

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**Amended Claims With Markings to Show Changes**

13. A method of carrying out Czochralski crystal growth comprising:

- (a) providing a crucible with a solid feed material therein, the solid feed material comprising each of the constituents of the crystal to be grown;
- (b) heating an upper portion of the crucible with an upper heater to a temperature sufficient to melt the feed material in an upper portion of the crucible and separately heating a lower portion of the crucible with a lower heater to another temperature which is below the melt temperature of the feed material so that the feed material in the lower portion of the crucible remains solid, wherein an insulator is positioned between the upper heater and the lower heater;
- (c) growing a crystal from the melt and drawing the growing crystal out of the melt; and
- (d) advancing the crucible with respect to the heaters as the crystal is drawn from the melt to heat additional portions of solid feed material with the upper heater to melt the additional solid material to replace the crystal drawn from the melt.

29. (Once Amended) A method of carrying out liquid encapsulated Czochralski crystal growth comprising:

- (a) providing a crucible with a solid feed material therein, the solid feed material comprising each of the constituents of the crystal to be grown;
- (b) heating an upper portion of the crucible with an upper heater to a temperature sufficient to melt the feed material in an upper portion of the crucible and separately heating a lower portion of the crucible with a lower heater to another temperature which is below the melt temperature of the feed material so that the feed material in the lower portion of the crucible remains solid, wherein an insulator is positioned between the upper heater and the lower heater;
- (c) growing a crystal from the melt and drawing the growing crystal out of the melt while covering the melt with a liquid encapsulant material; and
- (d) advancing the crucible with respect to the heaters as the crystal is drawn from the melt to heat additional portions of solid feed material with the upper heater to melt the additional solid material to replace the crystal drawn from the melt.